

UNITED STATES PATENT APPLICATION

Of

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For

METHOD AND APPARATUS FOR MANAGING OVERWRITE ON AN OPTICAL DISC
WRITE ONCE

[0001] This application claims the benefit of the Korean Application No. P2002-78889 filed on December, 11, 2002 and P2003-5212 filed on January, 27, 2003 and P2003-9896 filed on February, 17, 2003 and P2003-13199 filed on March, 3, 2003 and P2003-45316 filed on July, 4, 2003 which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a method and apparatus for managing overwrite on an optical disc write once.

Discussion of the Related Art

[0003] Recently, it is expected that a new HD-DVD (High-Density Digital Versatile Disc) on which video data and audio data can be written and stored in high qualities and in large quantities, for example, a BD-RE (Blu-ray Rewritable Disc), will be developed and produced.

[0004] The BD-RE, as shown in FIG. 1, is divided into an LIA (Lead-In Area), a data area, and an LOA (Lead-Out Area). In the head and the tail of the data area, an ISA (Inner Spare Area) and an OSA (Outer Spare Area) are dividedly arranged.

[0005] On the BD-RE, data is recorded in the unit of a cluster corresponding to a specified recording unit, and it is

possible to repeatedly record the data in a specified area of the BD-RE, which is called a physical overwrite. At this time, as shown in FIG. 1, it is detected if any defect area exists in the data area during recording the data. If the defect area is
5 detected, a series of replacement-recording operations for performing a replacement recording of the data recorded in the defect area, for example, in the ISA, is performed. Also, position information on the defect area and position information replacement-recorded in the spare area are recorded and stored as
10 a defect list in a DMA (Defect Management Area) of the read-in area as management information.

[0006] Meanwhile, the standardization of a BD-WO (Blu-ray Disc Write Once) has recently been discussed among companies concerned, and since the BD-WO is recordable only once over the
15 whole area of the disc, it is impossible to perform the physical overwrite on the BD-WO unlike the BD-RE.

[0007] However, it may be necessary to perform the overwrite on a BD-WO in order to edit the recorded data, to modify a part of the recorded data, or to offer convenience to a user or a host,
20 and thus an efficient scheme for this is urgently demanded.

SUMMARY OF THE INVENTION

[0008] Accordingly, the present invention is directed to a method and apparatus for managing overwrite on an optical disc

write once that substantially obviate one or more problems due to limitations and disadvantages of the related art.

[0009] An object of the present invention is to provide a method and apparatus for managing overwrite on an optical disc write once which make it possible to perform a physical overwrite on the disc and maintain the continuity of a user data area after performing the physical overwrite.

[0010] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0011] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a method of managing overwrite on an optical disc write once, includes replacement-recording data, which is requested to be overwritten in a specified area of the disc where recording is completed, from a rear of a user data area of the disc, and recording information on a last recordable position of the user data area, which is changed in accordance

with the replacement recording operation, in a management area of the disc.

[0012] In another aspect of the present invention, a method of managing overwrite on an optical disc write once, includes replacement-recording data, which is requested to be overwritten in a specified area of the disc where recording is completed, from an area preceding an outer spare area (OSA) of the disc, extending the OSA as large as a size of a replacement-recorded area, and recording information on a last recordable position of the user data area, which is changed in accordance with the extension of the OSA, in a management area of the disc.

[0013] In still another aspect of the present invention, a method of managing overwrite on an optical disc write once, includes replacement-recording data, which is requested to be overwritten in a specified area of the disc where recording is completed, in an outer spare area (OSA) of the disc, determining whether to extend the OSA in consideration of a size of a replacement-recorded area, and recording information on a last recordable position of the user data area, which is changed in accordance with the determination of the extension of the OSA, in a management area of the disc.

[0014] In still another aspect of the present invention, a method of managing overwrite on an optical disc write once having a plurality of recording layers, includes selectively

replacement-recording data, which is requested to be overwritten in a specified area of the disc where recording is completed, in a user data area of the respective recording layer of the disc, and recording information on a last recordable position of the user data area of the respective recording layer, which is changed in accordance with the replacement recording operation, in a management area of the disc.

[0015] In still another aspect of the present invention, a method of managing overwrite on an optical disc write once, includes receiving a recording command for requesting recording on a specified area of the disc, judging whether the specified area is an already recorded area or a non-recorded area, and if it is judged that the specified area is the already recorded area, replacement-recording data in another area of a user data area so that a continuity of the user data area can be secured even after the replacement-recoding operation.

[0016] In still another aspect of the present invention, an apparatus for recording/reproducing an optical disc write once, includes a controller for transferring a recording command for requesting recording on a specified area of the disc, and a recording device for judging whether the specified area is an already recorded area or a non-recorded area, and if it is judged that the specified area is the already recorded area, replacement-recording data in another area of a user data area so

that a continuity of the user data area can be secured even after the replacement-recoding operation.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0017] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In
10 the drawings:

 [0018] FIG. 1 schematically illustrates the construction of a BD-RE as a rewritable optical disc according to the related art;

 [0019] FIG. 2 illustrates the construction of a BD-WO as an optical disc write once according to the present invention;

15 [0020] FIGs. 3A and 3B illustrate a method of managing overwrite on an optical disc write once according to another embodiment of the present invention;

 [0021] FIGs. 4 and 5 illustrate methods of managing overwrite on an optical disc write once according to other embodiments of
20 the present invention;

 [0022] FIG. 6 illustrates a method of managing overwrite on an optical disc write once according to still another embodiment of the present invention;

[0023] FIGs. 7 and 8 illustrate management information associated with the method of managing overwrite on an optical disc write once according to the present invention;

5 [0024] FIG. 9 illustrates the construction of a BD-WO as a dual-layer type optical disc write once according to the present invention;

[0025] FIG. 10 illustrates a method of managing overwrite on a dual-layer type optical disc write once according to an embodiment of the present invention;

10 [0026] FIG. 11 illustrates a method of managing overwrite on a dual-layer type optical disc write once according to another embodiment of the present invention;

[0027] FIGs. 12 and 13 illustrate methods of managing overwrite on a dual-layer type optical disc write once according to still other embodiments of the present invention;

[0028] FIGs. 14 and 15 illustrate management information associated with the method of managing overwrite on a dual-layer type optical disc write once according to the present invention; and

20 [0029] FIG. 16 illustrates an apparatus for recording/reproducing an optical disc write once according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0030] Reference will now be made in detail to the method of managing overwrite on an optical disc write once according to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. In addition, general terms widely used are selected in describing the present invention. In specified cases, however, terms selected at the applicant's discretion are also used, but their meanings are described in detail in the corresponding parts of the description. Thus, it should be understood that the present invention should be grasp with the meanings of the terms, not the terms themselves.

[0031] The present invention makes it possible to perform overwrite even on an optical disc write once. Generally, the term "overwrite" means a repeated recording in a specified area of a rewritable optical disc. In other words, the term 'overwrite' is just the inherent characteristic of the rewritable optical disc, and thus, it is known that it is impossible to perform the overwrite on the optical disc write once.

[0032] However, the present invention makes it possible to perform a logical overwrite as it maintains the physical characteristic of the optical disc write once, i.e., the characteristic of write once, is maintained. Especially, by maintaining the continuity of the user data area after the physical overwrite operation, it heightens the use efficiency of

the disc. Now, diverse embodiments of the present invention will be explained, taking a BD-WO as an example.

[0033] FIG. 2 illustrates the construction of a BD-WO as an optical disc write once according to the present invention. The BD-WO (Blu-ray Disc Write Once) includes an LIA (Lead-In Area), a data area, and an LOA (Lead-Out Area). In the head and the tail of the data area, an ISA (Inner Spare Area) and an OSA (Outer Spare Area) may be dividedly arranged, and a user data area, in which data is actually recorded, is positioned between the ISA and the OSA. An LSN (Logical Sector Number) is given to the user data area, and a user or a host transfers a recording command with reference to the LSN. A recording device converts the LSN into a PSN (Physical Sector Number), which actually indicates position information in the disc, to perform the recording command.

[0034] Also, in the disc, a TDMA (Temporary Defect Management Area) is provided. A TDFL (Temporary Defect List), TDDS (Temporary Disc Definition Structure), SBM (Space Bit-Map) are recorded in the TDMA as management information. According to the present invention, in recording the management information after performing the replacement recording, position information on the original area and the replacement-recorded area is recorded in the TDFL, and the LSN, which indicates the continuity of the user

data area after the replacement recording, is recorded in the TDDS.

[0035] Also, the SBM information recorded in the TDMA represents '1b' if the corresponding cluster is an recorded area and '0b' if the cluster is a non-recorded area and vice versa, by allocating one bit for each cluster which is the minimum recording unit. Accordingly, it can be easily known where recorded areas and non-recorded areas exist in the disc by reading the SBM information. The recording/reproducing device can judge the recorded/non-recorded state of the corresponding area through the SBM information after it receives the user's recording command for recording the specified area, and if the specified area is the already recorded area, it performs the replacement recording of the data in another area of the data area to make the logical overwrite possible.

[0036] The management information such as TDFL, TDDS, SBM, etc., recoded in the TDMA is updated in the minimum unit of a cluster for a specified update timing, and in the optical disc write one, the area in which the management information such as TDMA is recorded is absolutely necessary.

[0037] In FIG. 2, if an already recorded area exists in the data area, it is not physically permitted to overwrite on the corresponding area due to the characteristic of the optical disc write once. However, if a recording command of a user or a host

requests performing of the recording on an A-B area (e.g., already recorded area) as shown in FIG. 2, the present invention makes a recording/reproducing device itself perform the replacement recording of data in another area in the data area.

5 Accordingly, the user or the host can command the recording irrespective of whether the specified area of the disc is recorded or not, and thus the user can use the optical disc write once just like the rewritable optical disc. This is called a logical overwrite (LOW) in distinction from the physical
10 overwrite.

[0038] Also, in carrying out the recording command on the A-B area as shown in FIG. 2, overwrite cannot be performed on the corresponding area since it is already recorded area. However, the recording command can be carried out in a manner that the
15 data is replacement-recorded in the data area, and especially in a position of the data area where the continuity of the user data area is secured, and the corresponding management area is recorded in the TDMA of the disc to complete the performing of the recording command.

20 [0039] FIG. 3A shows a method of managing overwrite on an optical disc write once according to the present invention. In replacement-recording the data of the area (e.g., A-B area) where the overwrite is requested in another area of the data area, in order to maintain the continuity of the user data area after the

replacement recording, the data is replacement-recorded from the front of the OSA, and after the replacement recording, the last recordable position of the user data area is changed. That is, before the replacement recording, the user data area has the last LSN information corresponding to the just front position of the OSA, but after the replacement recording, a new last LSN is given to the user data area. By doing this, the user or host commands the recording based on the LSN, and thus the already recorded area is excluded from the LSN. As a result, the continuity of the user data area is generally maintained, and this provides a convenient operation of the recording/reproducing device (the numeral '10' in FIG. 16) in performing the recording of the disc.

[0040] FIG. 3B is a partially enlarged view of the replacement-recorded area (e.g., a-b area). The replacement recording is performed from the old last LSN position, and after the completion of the replacement recording, the last LSN of the recordable user data area is given to the just front of the 'a' position, so that the next overwrite will be performed from the new last LSN.

[0041] The information according to the change of the last LSN after the replacement recording as described above should be recorded anywhere in the management area of the disc, and in the present invention, for example, the information is recorded in the TDDS of the TDMA. The TDDS includes a lot of general disc

management information, and since the latest information is recorded in the TDDS for each update timing, the TDDS would be most suitable for recording the management information.

[0042] FIG. 4 illustrates a method of managing overwrite on an optical disc write once according to another embodiment of the present invention. In replacement-recording the data of the area (e.g., A-B area) which is requested to be overwritten in another area of the data area, in order maintain the continuity of the user data area after the replacement recording, the replacement recording is performed from an area preceding the OSA, i.e., in the a-b area, the OSA is extended as large as a size of the replacement-recorded area, and then information on the last recordable position of the user data area, which is changed in accordance with the extended OSA, is recorded as the management information.

[0043] FIG. 5 illustrates a method of managing overwrite on an optical disc write once according to still another embodiment of the present invention. In replacement-recording the data of the area (e.g., A-B area) which is requested to be overwritten in another area of the data area, in order maintain the continuity of the user data area after the replacement recording, the replacement recording is performed in the OSA, the OSA is made to be extendable in consideration of the size of the replacement-recorded area after the replacement recording operation, and if

the OSA is extended, information on the last recordable position of the user data area, which is changed in accordance with the extended OSA, is recorded as the management information. Accordingly, the OSA may not be extended I consideration of the
5 size of the replacement-recorded area after the replacement recording operation, and if the OSA is not extended, the last recordable position information of the user data area will not be changed. Also, it is possible to extend the OSA before the replacement recording operation, and the extension of the OSA may
10 be performed during the system initialization or during the use of the disc in accordance with the user's request.

[0044] FIG. 7 schematically illustrates the structure of the TDDS in which the LSN information, which is changed through the replacement recording performed by the overwrite request, is
15 recorded according to the embodiments of the present invention of FIGs. 3, 4 and 5.

[0045] In the TDDS, a field for recording the position information of 'LSN = 0' and the position information of 'Last LSN' is provided, and whenever the TDDS is updated, the position
20 information of 'LSN = 0' and the position information of 'Last LSN' are recorded. Accordingly, in the embodiments of the present invention of FIGs. 3, 4 and 5, the replacement recording is performed according to the overwrite request, and the last LSN

information, which is changed through the replacement recording, is recorded.

[0046] FIG. 6 illustrates a method of managing overwrite on an optical disc write once according to still another embodiment of the present invention. In replacement-recording the data of the area (e.g., A-B area) which is requested to be overwritten in another area of the data area, in order maintain the continuity of the user data area after the replacement recording, the replacement recording is performed from an area preceding the OSA, i.e., in the a-b area, the OSA is extended as large as a size of the replacement-recorded area, and then the last recordable position of the user data area is changed after the replacement recording. In distinction from the embodiments of FIGs. 3, 4 and 5, according to the embodiment of FIG. 6, the last LSN value (before the OSA) given to the user data area before the replacement recording is maintained as it is, and a new last LSN is given to the user data area after the replacement recording. This is especially called the usable last LSN of the user data area.

[0047] FIG. 8 illustrates the management information recorded in the TDDS when the method of FIG. 6 is performed. The TDDS includes both the old last LSN value and the usable last LSN information changed after the replacement recording.

[0048] FIGS. 9 to 15 illustrate methods of managing overwrite on a dual-layer type optical disc write once according to embodiments of the present invention. Now, the embodiments of the present invention will be explained, taking a BD-WO as an example
5 of the optical disc write once.

[0049] First, FIG. 9 illustrates the construction of a BD-WO as a dual-layer type optical disc write once according to the present invention. In comparison to the single-layer type optical disc write once as illustrated in FIG. 2, the BD-WO of FIG. 9
10 shows the dual-layer type optical disc write once, and the two recording layers are called Layer0 and Layer1.

[0050] According to the dual-layer type BD-WO, the LSNs given to the user data area are consecutive values given from the end of ISA0 of Layer0 till the front of ISA1 of Layer1 (i.e., Last
15 LSN). To the LIA and the LOA, TDMA0 and TDMA1 for recording the management information are respectively allocated, and TDFL, TDDS and SBM information are recorded in TDMA0 and TDMA1 in the same manner as the single-layer type BD-WO.

[0051] FIG. 10 illustrates a method of managing overwrite on
20 a dual-layer type optical disc write once according to an embodiment of the present invention, which corresponds to the method of managing overwrite on a single-layer type optical disc write once of FIG. 3. In replacement-recording the data of the area (e.g., C-D area) where the overwrite is requested in another

area of the data area, in order to maintain the continuity of the user data area after the replacement recording, the data is replacement-recorded from the front of the ISA1 (e.g., c-d area), and after the replacement recording, the last recordable position
5 of the user data area is changed. In this case, the overwrite operation is performed in the same manner as the single-layer type optical disc write once. That is, before the replacement recording, the user data area has the last LSN information corresponding to the just front position of the ISA1, but after
10 the replacement recording, a new last LSN is given to the user data area. The management information is recorded in the TDDS of the TDMA, and as shown in FIG. 7, the new last LSN information value is recorded during the TDDS update timing.

[0052] In the case of the dual-layer type disc, the
15 replacement-recording of data in the front of the OSA or in the OSA of the single layer type disc as shown in FIGs. 4 and 5 can also be applied in the same manner, and in this case, ISA1 of Layer1 will be the extended spare area.

[0053] FIG. 11 illustrates a method of managing overwrite on
20 a dual-layer type optical disc write once according to another embodiment of the present invention, which corresponds to the method of managing overwrite on a single-layer type optical disc write once of FIG. 6. In replacement-recording the data of the area (e.g., C-D area) where the overwrite is requested in another

area of the data area, in order to maintain the continuity of the user data area after the replacement recording, the data is replacement-recorded from the front of the ISA1 (e.g., c-d area), and after the replacement recording, the last recordable position
5 of the user data area is changed. That is, the last LSN information (before the ISA1) given to the user data area before the replacement recording is maintained as it is, and a new last LSN is given to the user data area after the replacement recording. This is especially called the usable last LSN of the
10 user data area. The management information is recorded in the TDDS of the TDMA, and as shown in FIG. 8, the new usable last LSN information value is recorded during the TDDS update timing.

[0054] FIG. 12 illustrates a method of managing overwrite on a dual-layer type optical disc write once according to still
15 another embodiment of the present invention, which has the last LSN information with respect to the respective recording layer. In replacement-recording the data of the areas (e.g., A-B area and C-D area) where the overwrite is requested in other areas of the data area, in order to maintain the continuity of the user
20 data area after the replacement recording, the data of the A-B area is replacement-recorded in the front of the OSA0 (e.g., a-b area), and the data of the C-D area is replacement-recorded in the front of the ISA1 (e.g., c-d area). Also, after the replacement recording, the last recordable position of the user

data area is changed with respect to the respective recording layer. In this case, the replacement recording is possible for the respective recording layers of the dual-layer type disc. That is, before the replacement recording, the last LSN information is given to the user data area of the respective recording layer (e.g., Last LSNs of Layer0 and Layer1), but after the replacement recording, a new last LSN is given to the user data area of the respective recording layer. The management information is recorded in the TDDS of the TDMA, and as shown in FIG. 14, the new last LSN information is recorded for the respective recording layer during the TDDS update timing.

[0055] In the case of the dual-layer type disc, the replacement-recording of data in the front of the OSA or in the OSA of the single layer type disc as shown in FIGs. 4 and 5 can also be applied in the same manner, and in this case, OSA0 will be the extended spare area of Layer0, and ISA1 will be the extended spare area of Layer1.

[0056] FIG. 13 illustrates a method of managing overwrite on a dual-layer type optical disc write once according to still another embodiment of the present invention. In replacement-recording the data of the areas (e.g., A-B area and C-D area) where the overwrite is requested in other areas of the data area, in order to maintain the continuity of the user data area after the replacement recording, the data of the A-B area is

replacement-recorded in the front of the OSA0 (e.g., a-b area), and the data of the C-D area is replacement-recorded in the front of the ISA1 (e.g., c-d area). Also, after the replacement recording, the last recordable position of the user data area is
5 changed with respect to the respective recording layer. In this case, the replacement recording is possible for the respective recording layers of the dual-layer type disc. That is, the last LSN information (e.g., Last LSNs of Layer0 and Layer1) given to the user data areas of the respective recording layers are
10 maintained as they are, but after the replacement recording, new last LSNs are given to the user data areas of the respective recording layers. They are especially called the usable last LSNs of the usable user data areas of Layer0 and layer1). The management information is recorded in the TDDS of the TDMA, and
15 as shown in FIG. 15, the new last LSN information values are recorded for the respective recording layers during the TDDS update timing.

[0057] FIG. 13 illustrates an apparatus for recording/reproducing an optical disc write once according to the
20 present invention. The recording/reproducing apparatus includes a recording/reproducing device for performing the recording/reproducing on the optical disc, and a controller for controlling the device. The controller for providing a recording/reproducing command to the recording/reproducing device,

and the recording/reproducing device performs the recording/reproducing on a specified area of the disc according to the command of the controller. The recording/reproducing device 10 comprises an interface 12 for performing a
5 communication with the outside, an optical pickup 11 for recording or reproducing data on the disc, a data processor 13 for receiving the reproduced signal from the optical pickup to restore to a desired signal value, or modulating the signal to be recorded to a signal which can be recorded on the disc to
10 transfer the modulated signal, a servo unit 14 for controlling the optical pickup 11 in order to accurately read the signal from the optical disc or to accurately write the signal on the disc, a memory 15 for temporarily storing various information including the management information and data, and a microcomputer 16 for
15 controlling constituent elements of the recording/reproducing device.

[0058] During the recording operation, all the management information of the disc is read out and stored in the memory 15 of the recording/reproducing device, and the management
20 information is used for the recording/reproducing operation on the optical disc. The controller 20, if it is required to record data in a specified area of the disc, transfers the positional information to the recording/reproducing device along with the data to be recorded. The microcomputer 16 in the

recording/reproducing device 10 receives the recording command,
and judges whether the area of the optical disc in which the
controller 20 desires to record data is an already recorded area
or a non-recorded area from the management information
5 (especially, SBM information explained with reference to FIGs. 2
and 9) stored in the memory 15. If it is judged that the area is
the non-recorded area, the microcomputer 16 performs the
recording in accordance with the recording command of the
controller 20, and if it is judged that the area is the already
10 recorded area, the microcomputer 16 replacement-records the data
in another area of the data area, so that the continuity of the
user data area can be secured.

[0059] It will be apparent to those skilled in the art that
various modifications and variations can be made in the present
15 invention. Thus, it is intended that the present invention covers
the modifications and variations of this invention provided they
come within the scope of the appended claims and their
equivalents.